Altered Light Spectral Quality Impacts on Warm-season Turfgrass Growth and Development

Christian M. Baldwin, Haibo Liu, Lambert B. McCarty, Nihal C. Rajapakse, Hong Luo, and Joe E. Toler
Clemson University

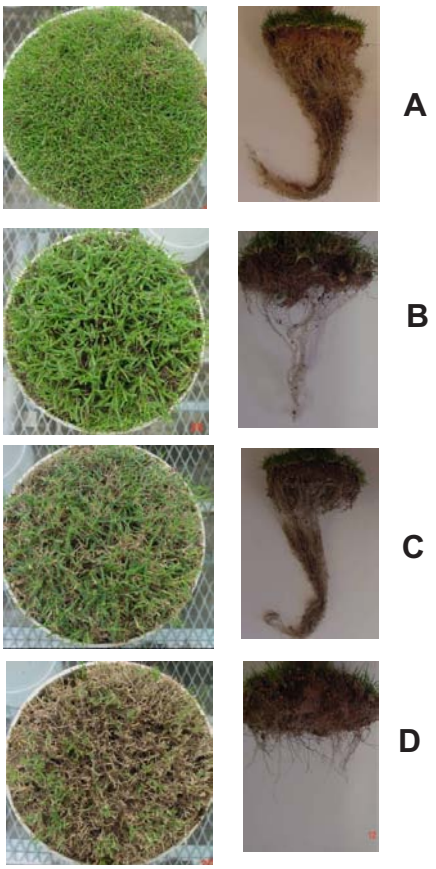
Objectives:

1. To investigate the physiological and morphological responses among warm-season turfgrasses to various light spectral qualities.

Start Date: 2007
Project Duration: two years
Total Funding: $6,000

Photosynthetic active radiation (PAR) available for plant growth is between 400 and 700 nm with ~90% absorbed by the plant with the remainder reflected at the leaf surface or transmitted through the leaf.

In nature, trees alter spectral quality available for turfgrass development, however, limited research has investigated the light specific tree species filter in highly maintained turfgrass environments. Also, most bermudagrass shade research has focused on light quantity by filtering shade with black neutral cloths.



Shoot and root growth of (A) 'Diamond' zoysiagrass, (B) 'Sea Isle 2000' seashore paspalum, (C) 'Celebration' bermudagrass, and (D) 'Tifway' bermudagrass following six weeks exposed to 65% light reduction under the blue shading material.

Light treatments included a control (full-sunlight) and four different color shade cloths filtering wavelengths 560 - 720 nm (blue shade cloth), 360 - 520 nm (yellow shade cloth), 360 - 560 nm (red shade cloth), and 360-720nm (black shade cloth). Red to far red ratio for each cloth was ~1.171, while percent light reduction for each cloth was ~65%.

Every two weeks, shade cloths and lysimeters under each shade cloth were re-randomized in the greenhouse to minimize any microenvironmental impacts. Data collection included visual turfgrass quality (TQ), clipping yield, lateral spread, total shoot chlorophyll, leaf width, total root biomass, root length density, specific root length, and root and shoot total non-structural carbohydrates.

In full sun, all turfgrasses TQ scores were above 7, however, 'Diamond' zoysiagrass consistently showed highest ratings throughout the 8-week study. At the end of the study, 'Celebration' bermudagrass had 14%, 34%, and 74% greater chlorophyll than 'Tifway' bermudagrass, 'Sea Isle 2000' seashore paspalum, and 'Diamond', respectively. 'Celebration' and 'Sea Isle 2000' had the most prolific horizontal spread compared to 'Tifway' and 'Diamond', while 'Diamond' and 'Tifway' had greatest vertical shoot growth. 'Diamond' had the finest leaf texture compared to other turfgrasses, while 'Sea Isle 2000' had the widest leaf texture.

Poorest TQ scores were noted for black shade across all cultivars, while yellow and red shade showed similar TQ scores. The only cultivar to maintain acceptable TQ (>7) in shade was 'Diamond'. 'Sea Isle 2000' had higher TQ scores than both bermudagrass cultivars, but 'Celebration' showed greater quality compared to 'Tifway'. However, 'Sea Isle 2000', 'Celebration', and 'Tifway 'scores remained well below acceptable threshold of 7. 'Diamond' was the only turfgrass not to show a significant decline in shoot chlorophyll concentration, while black shade was most detrimental for the other turfgrasses.

Shade type had minimal impacts on leaf width for most turfgrasses. However, 'Tifway' had thinnest leaf blade under black shade, while yellow and red shade produced a wider leaf blade than blue and black shade. For lateral spread and clipping yield, blue, black, and red shade reduced horizontal spread compared to yellow shade, while black shade reduced clipping yield compared to other shade types. Parameters currently being analyzed include carbohydrates (root and shoot) and root (specific root length, mass, and root length density) data. Overall trends indicate the most detrimental type of shade was the black shade cloth, which most closely represents stadium/building shade, as it consistently reduced TQ scores, chlorophyll concentrations, vertical shoot growth, and lateral spread.

Summary Points

- Greatest TQ scores within the various light environments: full-sun (greatest) > yellow = red > blue > black (poorest).
- Turfgrasses performance varied when grown in various shaded environments: 'Diamond' zoysiagrass (best) > 'Sea Isle 2000' seashore paspalum > 'Celebration' bermudagrass > 'Tifway' bermudagrass (poorest).
- Trends indicate the most detrimental type of shade was the black shade cloth, which most closely represents stadium/building shade, as it consistently reduced TQ scores, chlorophyll concentrations, vertical shoot growth, and lateral spread for all turfgrasses.
- This study implies different types of shade significantly impact the performance of warm-season turfgrasses.